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PERMANENT ADDRESS:

.....3(8, MICHENER PARK
.....EDMONTON
.....

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UNIVERSITY OF ALBERTA

THE SOVIET THEORY OF SET - AN EVALUATION

by

COLIN PARK

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "The Soviet Theory of Set - An Evaluation" submitted by Colin Park in partial fulfillment of the degree of Master of Education.

L. L. Stevenson.....

Supervisor

John Orbane.....

Thomas Kieren.....

Date October 4th 1974

To Jonathan and Adam,

who know why.

ABSTRACT

The development is outlined of the Soviet (Uznadze) theory of set as a 'unitary' and 'global' determiner of all behaviour. A previous investigation, based on this notion of set (and which may be taken, in intent at least, as a paradigm for others) is critically examined, and an attempted replication is reported. It was found that the global nature even of perceptual set could not be established, and it is suggested that this, together with the severe limitations on the actual measurement of perceptual set indicate that the Soviet theory may not be founded on fact. Finally, the usefulness of the general notion of 'set' is examined.

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CHAPTER I

The Experimental Background

The Soviet 'Theory of Set', or the 'Uznadze Theory of Set', as it is commonly called, after its most prominent developer, gives the impression of an appealing theory which has started to run wild. By this is meant that the initial impression of earlier work is one of reasonableness, backed up by sensible-sounding data, whereas recent suggestions - for example, that one's use of language is closely related to one's formation and loss of certain perceptual illusions - seem intuitively far-fetched and unreasonable. It was therefore decided to investigate the internal validity of the theory, primarily using the type of analysis suggested by Cronbach and Meehl(1955), as well as to attempt a replication of one recent study(Hertzog, 1967).

In this Chapter, the development of the theory will first be outlined very briefly, for this development is rather striking among psychological theories, and leads one to appreciate how relatively recent claims for the theory may have achieved credibility. However, as will appear, these claims may be unfounded, and indeed, may be instrumental in pointing up weaknesses in the basic theory itself. Hence, some questions concerning such claims will be raised following this summary of the development.

The material of this review of the experimental

background is taken almost entirely from Natadze(1960), and individual research projects cited there will not be referenced. A full bibliography of 40 papers is given at the end of that article. Very little of the material cited by Natadze is available in English; 25 of the 40 are not even in German or Russian, though resumes of three apparently exist in Russian. Any references to other work will be cited in the usual fashion.

Although some terms are defined in the present text, readers unfamiliar with the terminology of Soviet set theory are recommended to read through the Glossary of Terms in the appendix.

The Experimental Background.

The foundation of the theory of set was laid when the Soviets recognized that Fechner's "motor set", used to explain the well-known 'weight illusion', was in fact a subspecies of a broader phenomenon. In this experiment, a subject, after repeatedly raising a heavier weight with one hand, and a lighter with the other, normally experiences, when lifting two equal weights, a sense of lightness in that hand which previously raised the heavier weight. (Conversely, the other hand feels as though it is being dragged down). Uznadze's colleagues showed that this was not necessarily a "motor-muscular" phenomenon (Natadze's expression), by having subjects compare the sensation of pressure of two equal bodies, one on each hand, after

repeatedly feeling the pressure of unequal weights, the heavier one always on the same hand. In the case of equal weights, the subject (who does not know that the weights are equal) feels the pressure to be less on that hand, most commonly, which previously suffered the greater pressure. Natadze quotes Bochorishvili (1927) as stating that 71% of his subjects had such a contrast illusion, 15% had an assimilative illusion, and 14% showed adequate perception. (Natadze does not point out that such an illusion might be reasonably attributed to a motor set, since it is possible that we estimate pressure effects, especially with such sensitive and manipulable (and therefore finely-muscled) organs as our hands, by imperceptible resistance in the muscles to applied pressure. However, this kind of argument in general is rendered unnecessary by conclusions from the sequence of experimental results to be outlined below, a sequence which takes us far from the realms of motor responses or muscular tensions).

A second experiment, this one by Khmaladze in 1938, indicated that similar set developed in subjects judging the sizes of objects (wooden spheres) by grasping them, with their eyes closed, or blindfolded. Again, this could clearly be a motor set, though of a slightly different nature from that assumed in the weight-lifting experiment. Here, the strength of the contraction is not of importance, but the degree of contraction required to position the fingers around the spheres. Generally, this seems to be a

strong illusion - most people form the illusion (97% after 15 setting trials, in the work cited by Natadze), and, "as a rule" (Natadze) the subject suffers a contrast illusion.

Both the pressure illusion and the haptic illusion are also reported to arise when the weights (or spheres) are placed successively in one hand, alternating heavy (or larger) with lighter (or smaller). In the case of the pressure illusion, for example, when equal weights are presented in succession, the illusion is again manifest. If the smaller had always been presented after the heavier, then the second of the equal weights was usually reported by the subject to be the heavier, a contrast illusion. Similar illusions in size-judgement arise with the spheres. Natadze does not give references to this work by Adamashvili (pressure illusion) and Khmaladze (haptic illusion).

All the above-mentioned experiments involved kinesthetic or tactile senses in the formation of the illusion. Further experiments involved sight; subjects were 'set' to unequal circles, displayed for only a brief time interval, and in a field sufficiently small that no scanning movement was required to see the whole image. Once again, a fixed set was reported, and now the kinesthetic element had been removed. (Once more, this work, by Khmaladze, is not referenced).

However, the visual judgement of size may be associated with our kinesthetic or tactile senses, so that the next step was to investigate set in hearing, this time presenting

pairs of tones, the first louder. On presenting equal tones, (presumably between the setting tones in intensity, though this is not stated), an illusion was experienced in "76% of the cases". Similarly, in setting for degrees of brightness of two equal-sized grey squares, presented tachistoscopically, 73% of subjects suffered an illusion. Finally, an unpublished report is mentioned in which subjects are set with two equal circles, the first containing a large number of dots, the other a large, but clearly smaller number. Subjects are required to state which circle has the larger number of dots, and after setting, "the majority" exhibited a contrast illusion in this "perception of a group of elements".

Next, since set was considered to be an 'integral' aspect of human functioning, the effect of a set fixed in one modality on perception in the other modalities was investigated. Transfer of the illusion was found to occur frequently, and the subject's set was said to have 'irradiated'. The phenomenon was first established by Uznadze in 1932 within the haptic modality, but transferring the illusion from one hand to the other: the subject is set with successive haptic perception in one hand, and tested with successive presentations of equal spheres in the other hand. 83.5% of cases were reported to have experienced the illusion, 60% of the total reporting a contrast illusion. Thus, the illusion was demonstrated to have transferred from one hand to the other. Similarly, a haptic set was found to

produce an illusion of unequal circles when equal circles were presented tachistoscopically. However, the setting tasks were repeated "15 to 25 times", and resulted in only 56.4% of the cases exhibiting transfer of the illusion. This should be contrasted with Hertzog's (1968) work (to be discussed below), where there was apparently no difficulty in establishing the transfer. In my own work, to be reported below, practically no transfer was found at all. Natadze states that a visual-to-haptic transfer can take place, but no data or references are given. This case would be even more interesting, since visual set in itself is noticeably weaker than haptic set.

Natadze then states that Uznadze recognized and overcame, in 1936, the objection that all of the above phenomena could be explained by the theory of "deceived expectation". (The name is self-explanatory. However, it seems that it may be stretching the expectation notion to use it to explain the <u>transfer</u> of an illusion from one modality to another). To disprove this notion, a haptic set was established in a subject in a hypnotic trance. He was also instructed to forget everything that happened while in the trance. On awakening, critical tests showed that the subject had established a set, even though he could clearly have no expectations. No data are given, and the language of the report does not rule out the possibility that only one subject was used. Indeed, the present author has himself evidence of an involuntary set arising <u>contrary</u> to

expectation: on trying on empty spectacle frames at the optician's, the author's eyes 'adjust', as though they 'expected' correcting lenses, and of course go out of focus. Naturally, the subject is in this case aware that the frames contain no lenses! (The eyes readjust after a few seconds, or almost immediately with a conscious effort).

Further aspects of the formation of set are described by Natadze under the heading of 'Qualitative Set', though no statistics are given of the setting tasks, or individual differences in ease or difficulty of establishing a set. He states only the bare fact that 100% of subjects suffer these illusions. Perhaps the most striking example of qualitative set is the problem of recognizing Russian words written in 'neutral' Latin script - that is to say, the script letters used occur in both German and Russian, but with different associated sounds. A number of German words are presented to the subject tachistoscopically, and when a set is established, Russian words are presented, consisting only of neutral letters. The subject usually reads the Russian words, which, once again, are in familiar Slavic script, as though they were foreign words[1].

In a second type of setting, Eliava is reported (in Natadze, 1960, p 617) to have repeatedly shown subjects

---

[1] The editor or typesetter has made errors in the footnote to Cole & Maltzman (1969), page 616. The first 'nonsense' word should end with 'g' not 'q', and its first letter should be upper case 'H'; also, it is not immediately clear that the *r* in "*norma*" and "*mopra*" could be read as a Latin script 'r', since the rest of these words is in printed form.

pictures of sailboats; on then producing pictures of a lotus flower, the petals were seen as sails, even to the point of producing the surprised comment, "Why do they grow out of the ground?" Eliava also demonstrated set in the middle of thought. Subjects absorbed in reading a passage 'having a fascinating content' do not notice, on turning the page, that the material no longer follows the theme. It is noted that "obviously, a selection of appropriate texts is of crucial importance in order to obtain the necessary effect" (ibid).

In summary, we see that the phenomena of set have been demonstrated in estimates by subjects of relative weights, relative pressures, relative sizes of solids or of plane figures when presented briefly; in relative intensities of successive sounds, in relative brightness of figures, and in perception of a group of elements. It has been shown that motor-set and 'deceived expectation' are both incapable of explaining some of the observed phenomena. In addition, setting to 'quality' has been reported, and examples have been mentioned of the mistaking of flower petals for sails, of the reading of Russian words written in a neutral script as though they were foreign, and in the failure to recognize that the material of a passage had lost its continuity on turning a page.

More recently, other aspects of perceptual set have been investigated, giving hints as to its integral or integrating nature. Bzhalava (1968) found interesting

evidence of the non-peripheral nature of perception in some ingenious experiments involving after-images. In one experiment, subjects 'saw' the after-image of a triangle, which had just been briefly illuminated, change size as they drew the board with the triangle on it toward them in total darkness. (The image is reported as decreasing in size in this case, increasing when moved away). Flexing the arms in similar fashion (i.e. giving the same muscular feedback as when the subject held the board), but with the experimenter holding the board with the stimulus painted on it had no such effect. However, the effect was restored when the experimenter slid the board along the skin of the subject's arm toward his eyes. (Again, the image is said to decrease in size). Furthermore, if the subject looked to the right ('seeing' the after-image in that direction), while holding his arms forward, no change in size was perceived as the experimenter slid the board along his arm. Thus modes of perception are seen to reinforce each other. In a second experiment Bzhalava (ibid) showed that subjects went through the stages of setting, (having previously been 'set' for unequal circles) with the after-images of two equal circles which had been illuminated for such a brief time (one-fiftieth of a second) that they could not perceive what the stimulus was. That is, images were seen which were first of all small circles, growing in size, and then becoming unequal. Subjects are reported to have made such comments as "Perhaps they were circles, but I cannot say anything

about their size", referring to the original stimulus. The inference is drawn that set is completely internal, not requiring immediate perception.

Finally, going beyond the notion of set unifying and integrating all of human behaviour, insofar as this is indicated by the experiments on perception and set in 'quality' cited above, the properties of changes in set in an individual over time have been found to be of interest, and, especially, have been found to be associated with some mental illnesses, most notably with schizophrenia in that the characteristics of set are said to differ to a remarkable degree from those observed in normal subjects. (This work is cited by Natadze, p 622, from studies of Bzhalava, 1968).

For example, subjects differ in the ease with which they form a set in some of the perceptual tasks described above. Some may require only one or two 'setting' trials before a set is fixed. Others under identical circumstances may require twenty or more. Similarly, persons in whom a set has been established may 'extinguish' (reach veridical perception) after three or four critical trials, or only after twenty or thirty, or even, in rare cases, not at all during the course of the experiment. Subjects who maintain a set during the course of an experiment are said to have a 'static' set; those achieving veridical perception have a 'dynamic' set. In achieving veridical perception, subjects may go through the sequence: contrast illusion -

assimilative illusion - veridical perception. Subjects passing through all phases are said to have a 'plastic' set. If the same type of set manifests itself in the same subject at different times, the subject's set is said to be 'constant'. Otherwise it is 'variable'. A fixed set preserved over time without being tested by critical trials is said to be 'stable'. Otherwise it is 'labile'. (The same terms may be used during the presentation of critical tests - see for example, Natadze (1969), p. 615-616).

Now, these various set characteristics are said to be related to personality characteristics. Norakidze writes, for example:

> The type of dynamic, static and variable sets - established by the method of fixated set - reflect only the formal-structural aspect of personality. TAT and Rorschach's test have proved symptomatic in studying the content/motivational components of a person's set.
>
> The content of a set evolved by means of the projection techniques corresponds to the formal side of a person with a dynamic set, harmonic [sic] and adjusted to the environment. This content points to the individual's capacity for facile adjustment to his environment, inner wholeness, harmoniousness, self-possession in a critical situation, sincerity, optimism of emotions, whereas the personality structure of an individual with a static, rigid, and maladjustive set is essentially related to all of the above-discussed properties revealed by the projection methods. (Norakidze, 1973)[2]

Thus, Natadze writes:

> A characteristic feature of schizophrenics was an extremely high excitability of the set, an extraordinary irradiation, and a sluggishness and

---

[2] The awkward English seems to be simply a translation problem. This extract is taken from a summary of an article in Russian in the same book.

staticness of the set....(1969, p. 622).

Now this indeed seems startling, for since the set characteristics referred to above are based on a few simple perceptual measures - and this is important, for there are very few objective measures of a person's current state of 'set' available to us - these characteristics are said to parallel, in some sense, those curious, complex and widely divergent determiners of behaviour we call personalities. (The present author has been careful not to suggest that set 'determines' personality, or vice-versa. In the Uznadze theory, set merely is the underlying 'state of readiness' for activity, but either set or personality could be regarded as a function of the other. From the Soviet viewpoint, set and personality must be inextricably entwined, and it would be futile to look for causal relations, set at any one time being determined, like personality, by the sum of one's past experience).

Possibly even stranger is the proposition that set, again, as measured by these perceptual tasks, and one's use of language are closely related, (Hertzog, 1967; Janzen, 1971). Language and set are considered to be brought together, conceptually, as a result of the process known as "Objectification". When behaviour proceeding normally (along with normal perception) with a non-fixed set meets some obstacle or difficulty, the individual becomes conscious of the obstacle or difficult situation, clarifies or objectifies the situation, and adjusts his action

appropriately, (under normal conditions, though of course his adjustment could in itself be inappropriate). Thus, his set is changed. In this way, thought (and hence, ultimately, the faculty of language) is thought to arise during objectification. However, psychologists and socially concerned citizens alike are very much at home with the theory that language is a socially-determined phenomenon in almost every aspect. The gulf between the language of the average brick-layer's mate (with no speech or language defect, as judged by the standards of brick-layers' mates) and that of a Psychology Department Chairman (with no language defect except that imposed on him by virtue of his delicate position) is truly enormous. Yet it is difficult to imagine them necessarily having grossly different set characteristics, as measured by the perceptual tasks. In other words, the range of possible variations in the use of language would seem to exceed by far variations in the population detectable by these simple perceptual measures. We return to this point later, but for the time being, common sense warns us that we seem to be heading for trouble.

Nevertheless, the notion of 'set' at a higher level than perception is intuitively appealing. Surely we have all failed to find some lost article because we were too firmly 'set' in an erroneous image of it, or wrongly but firmly convinced that we had left it in a particular place; or have failed repeatedly to solve a simple problem, because

we were tackling it in the wrong way (cf. the 'water-jug' problems of Luchins' classic investigations, Luchins, 1942). Indeed, 'looking at the problem a different way' - i.e. breaking a cognitive set - is a deliberate technique recommended by the reknowned mathematician and educator, George Polya (1957).

In the next chapter, a brief outline is presented of Hertzog's (1967) thesis, "Set Characteristics of Linguistic Codes", since questions arising from that thesis gave the initial impetus to the present study. Then in the light of this work and the comments presented above, the need to attempt a replication is argued.

CHAPTER II

"Set Characterisitics of Linguistic Codes"

The work of R. L. Hertzog.

In his doctoral dissertation of the above title, Hertzog (1967) claimed to have established a clear association between, on the one hand, the 'set' characteristics of his subjects, measured in the haptic and visual modalities with the tests on the sizes of spheres and circles mentioned in the previous chapter, and, on the other hand, their level of language performance as measured by a number of scales applied to samples of written work. As indicated in the previous chapter, the conclusion is astonishing. However, if indeed the mutual interaction of language and behaviour does result in a set with such recognizable common characteristics in both language and perception, the result is of clear importance for general psychology and for educational psychology. Clear (even if imprecise) and simple methods of measuring flexibility of functioning and degree of integration immediately become available. Also, in areas where speech or language performance itself is not the object of testing, such measures of flexibility could be applied without the difficulties concomitant with the use of language as part of a test instrument. However, it may be that the matter is not so clear-cut as one might suppose from a survey of Hertzog's conclusions.

In the present author's work, to be described below, it was found that there was no way in which particular set characteristics could be unambiguously ascribed to the experimental subjects, and hence there was no point in extracting language measures. Nevertheless, it will put matters in perspective, and provide a proper focus to the discussion of the set-language relationship if we outline Hertzog's approach. Moreover, it is the author's opinion that the set/language problem brings out most effectively the inherent limitations of the Soviet theory of set itself, (see below, Ch. V).

Hertzog based his measures of language complexity on the theory of Bernstein (1962a, 1962b), a theory in which the code used is hypothesized to be jointly determined by social learning and social necessity. Parenthetically, we note in particular that Bernstein states:

> Access to an elaborated code will depend not on psychological factors but on specialized social positions within the social structure, by virtue of which a particular type of speech model is made available (1962a, p. 33)[3].

Thus if Hertzog claims that a positive correlation exists in each individual between language code and set type, with the former explicitly moulded by a social-class strucure, one

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[3] Although Bernstein does not explicitly make the point, such a distinction would presumably only begin to have effect after the stage of concrete operations, when the world of 'ideas' is beginning to have more relevance to the child. Criticisms which have been levelled at other sociolinguistic work in the context of explaining failure in school have been for the greater part concerned with research on the earliest school years. (See Lawton, 1964).

would reasonably assume that set is itself shaped by social class, either directly, through reinforcement similar to that which delimits the speech code, or indirectly as a result of the 'regulative' effect of the speech code. But since the set examined by Hertzog was in the haptic and visual modalities, it is very difficult to see how either process could account for the formation of such a set. In particular, one would imagine that in our society, at any social level, correct determination of spatial dimensions would be of great importance. One would surely be surprised to find a distinction by haptic set or visual set across social classes. But, despite the fact that Hertzog explicitly makes use of Bernstein's theory, he makes no mention of the social class of his subjects. (We note, however, that Hertzog states (p. 69), " - it would appear that the formulation of Bernstein is unnecessary"). The source of the relation seen by Hertzog between set characteristics and language performance is probably best indicated by the "Postulate" he presents at the head of his chapter on Hypotheses (p. 37):

> Set is the psychological state of readiness which underlies, determines, and directs all psychological functioning of the individual. The more dynamic the psychological state of readiness for activity, the more effective will be the interaction of the individual with his environment, and the more adequately will information about the environment be processed by the individual.

To indicate the kind of linguistic analysis used by Hertzog, a few examples of the scales he used will be given.

The scales were applied to two essays written by each subject.

(1) Egocentric-Sociocentric sequences ratio. ("I think" vs "You know"). This is taken direct from Bernstein's work, but may be inappropriate in the context of written language, these being modifiers frequently attached to sentences in spoken English. However, the point is open to question. (Bernstein's analysis is mainly done in discussion groups). It may also be misleading in the essays entitled "My life in 1976", as may be the count of personal pronouns which Hertzog did, since the introduction of the possessive adjective forces the subject to respond "egocentrically".

(2) Total finite subordinate clauses divided by the total number of finite verbs.

(3) Subordinate adjective clauses: the ratio of the number of subordinate adjective clauses to the number of finite verbs.

(4) Uncommon subordinate clauses: ratio of the number of subordinate clauses less noun clause objects and adverb clauses of time, to the number of finite verbs.

(5) The Loban index of subordination. This is a composite score obtained by assigning points to different types of subordinate clause. (For example, a subsidiary clause itself embedded in another subsidiary clause is assigned two points). The points total is divided by the number of words.

Clearly, some of these measures are interdependent, and

should not be used as separate measures of complexity, as Hertzog did.

Similarly, Hertzog counts 'total adjectives' and 'uncommon adjectives', 'total adverbs' and 'uncommon adverbs', again partly confounding the scales, since some of the 'total adjectives (adverbs)' must be contained in the 'uncommon adjectives (adverbs)'. These are not then separate measures of complexity.

We see in outline then, how Hertzog intends to search for the set/language-ability relationship. He first proposes that "...set is the psychological basis for the relation established between the perceptual complex and the meaning of a word", and cites Uznadze ('in Natadze,1961') and Sokolov as his authority:

> As a result of set developing which corresponds to a particular situation, we begin to talk in a language... which corresponds to the same situation; a stream of words and expressions now flows into our consciousness, and these are in the language appropriate to the given situation... The onset of speech is determined by a set... (Natadze,1961, p. 308)
>
> What is meant by a perceptual complex is best understood by the work of Sokolov (1963). According to Sokolov, any given perceptual act not only is a function of the corresponding area of the sensory cortex, of the given modality, but also involves the integrated activity of the entire cortex. (Hertzog,1967, p. 32)

Hertzog then goes on to quote (p. 32) in short order: Bernstein [who] 'maintains that speech marks out what is relevant in the environment'; Langer, 'what becomes meaningful for the individual in any given situation is a function of the kinds of relationships that become

established between signals which the individual attends to'; Ausubel, 'As discrimination is enhanced by speech, complex cognitive differentiation ensues'; and Uznadze, 'With the establishment of this cognitive relation, he can now act according to the reality objectified in speech, since that which is designated by a word has thereby already become objectified... That is to say, set can arise not only as a result of a specific concrete situation, but also as a result of a situation on the verbal plane...'

Having defined the (putatively) set-based properties of language (variety in the language code, fineness of discrimination, complexity of structure), Hertzog now wishes to establish his subjects' state of set (via the perceptual tasks), and to compare the language characteristics of subjects with distinctly different sets.

We now examine how Hertzog measures the set of his subjects. Curiously, he uses five different measures which he never compares. It is curious in two senses: firstly, set is most emphatically a unitary concept in the Soviet theory: 'Set is the psychological state of readiness which underlies, determines and directs all psychological functioning of the individual' (supra p. 17). Why, then, even consider five independent measures? Why not average out, in some fashion, the five scores, and form a composite (and presumably more reliable) score? Second, having obtained five measures of set, and assuming each to be a measure of the same thing, i.e. the subject's total set,

surely common sense would lead one to compare the measures - for example, by checking the correlation between them. This was not done, and since Hertzog did not provide the original data (which under other circumstances would certainly not have been necessary), we are unable to check these points.

To be sure that the matter is quite clear, we present Hertzog's position as put by himself in his 'Major Hypothesis' section:

> The set characteristics which are determinants of the more adequate information processing as defined by the use of elaborated codes [emphasis added] are:
> (1) high excitability: fewer setting trials are required to fixate set in the visual and haptic modalities.
> (2) rapid extinction: fewer critical trials are required to reach adequate perception.
> (3) strong irradiation: fewer setting trials are required for the transfer of a set fixated in the haptic modality to the visual modality (Hertzog, 1967, p. 37).

Clearly, then, rate of excitation in both haptic and visual modalities, rate of extinction in both modalities, and rate of establishing irradiation should all be fairly well correlated.

A second element of doubt concerning Hertzog's methodology arises from his grouping of subjects for the purpose of language comparisons:

> Eighty subjects in total were tested. All subjects were in their first year of student nursing at three hospitals in Edmonton, Alberta. The sample of eighty includes: University of Alberta Hospital - forty subjects; Royal Alexandra Hospital - fifteen subjects; Misericordia Hospital - twenty-five subjects (Hertzog, 1967, p. 39).

There was never any indication that more than eighty

subjects were used and some rejected. The eighty subjects were divided according to performance into 'high' and 'low' groups on each of the five set measures: trials to fixation in haptic and visual modalities; trials to extinction in these modalities; and trials required to cause transfer from the haptic to the visual modality. The 'high' excitability sample in each modality and the transfer case were defined as subjects fixating, extinguishing or transferring in five trials or less. The low excitability group performed in fifteen trials or more. Hertzog reports exactly eight subjects in each of the ten groups; this further implies that no subject scored between five and fifteen!

These two remarkable circumstances warrant no further comment, except to point out that one could select each subject individually to go into one of the groups, if one ignored his performance on all the other tests (though even then, it might well be difficult to end up with exactly eight subjects in each group). However, this would obviously make nonsense of the set concept, since it would leave the experimenter consciously rejecting some results of one subject because (for example) they were too 'low' to fit her into a 'high' group where one score places her.

Though not of immediate concern in the problem of the set/language relationship, one further point casts yet more doubt on the scientific value of Hertzog's experimental work. It has to do with the reliability of the set measures, and, as will be shown, is of basic importance.

"In order to ascertain the stability of the set characteristics, a test-retest reliability check was done using the Spearman rho"[4]. For 25 subjects, the correlations between the first and second measures (after one week) were: .98, .98, .98, .98, and .99 (page 470). Yet Uznadze(1966, pp. 84,85) found it necessary to define the terms 'constant set' and 'variable set' precisely because set characteristics may not have the unusual stability which Hertzog finds, although Uznadze does indicate that a considerable variation is symptomatic of some abnormality. Once again, it is unfortunate that Uznadze does not give numerical indicators of this parameter. What degree of variability lies within the 'normal' range?

It is clear from the references to Hertzog's work that the relationship he postulated between set and language can not be taken as demonstrated. (A number of weak points concerning the linguistic analysis, not of immediate relevance in our discussion of set theory itself are not considered here). Further, since no evidence is available in the English-language literature at least concerning the correlations between the different modalities of perceptual set, and may well not appear in the Soviet literature, since reporting anything more complex than proportions has

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[4] One might also question why Hertzog used ranked scores, thus throwing away the information of the actual scores. We note also that Hertzog did not repeat his language measures, or mention the need for it, which would seem to indicate that he considered his results a foregone conclusion.

traditionally been most uncommon there, it seems that the empirical foundations of the Soviet theory of set may merit serious re-evaluation.

In the case of set with tachistoscopically presented circles, further justification for this suggestion came to light when Cowper (1973) found no significant difference in number of trials to veridical perception between subjects who had undergone setting trials and control subjects who had not. There was in fact a clear difference in the distribution of the responses, which indicated, as one would expect, that the control subjects did not know how big a difference they were expected to recognize, and, perhaps on the basis of slight perceptual errors, persisted (in many cases) in claiming a difference in circle size where none existed. The particular significance of this is that one is then unclear as to the meaning to be attached to responses of subjects beginning to extinguish a set.

In the light of the above, an attempt to replicate Hertzog's work was made.

For each of the ten correlations between the pairs of variables, haptic set formation, haptic set extinction, visual set formation, visual set extinction and haptic-to-visual irradiation, the following hypotheses are testable:

H_o: The correlation will not be significantly different from zero;

H_1: The correlation will be positive, and significantly different from zero.

However, only the five 'strongest' requirements will be tested. It is far more reasonable to require that, for example, haptic set formation and visual set formation should be closely correlated than should haptic set formation and visual set extinction. The pairs to be tested are: haptic formation vs haptic extinction; visual formation vs visual extinction; haptic formation vs visual formation; haptic extinction vs visual extinction; and haptic formation vs irradiation.

Clearly, because of the unitary nature of the set concept, it would be preferable to test the hypothesis that the whole correlation matrix is significantly different from a zero correlation matrix. However, this was not possible, because measurement problems forced unequal n's between the different pairs of correlations, and the subjects for whom the different pairs of correlations were calculated were not necessarily the same as all those in the smallest sample, (so that subjects could not be randomly rejected to bring the n's to the same value).

The experimental procedures, along with the rationale for them, are described in the next chapter.

CHAPTER III

Experimental Method.

Central to the experimental investigation of this thesis was the notion that Hertzog's experimental conditions should be reproduced as closely as possible, in order to preclude the argument that any resulting differences might be due to differences in sampling or experimental techniques. However, for reasons to be cited below, a pilot study was carried out before the main study, and a small investigation afterwards. The three are outlined in this sequence.

In attempting to measure set, four specific problems were apparent:

(1) The problem of recognition of perceptual biases or difficulties;

(2) The problem of recognition of when a set had been established or irradiated;

(3) The problem of recognition of when a set had been extinguished - that is, of distinguishing perceptual errors from set effects;

(4) The problem of the unwillingness of some subjects to repeat one response ("equal") five times in a row - the traditional criterion of veridical perception. This problem became apparent in testing the first few subjects.

The first of these problems seemed obvious from the

start, yet no mention of the need to check for perceptual bias or error was found in any of the literature. (It is also the only one of the problems resolved with any degree of satisfaction).

The second and third problems were indicated partly by the results of Cowper (1973) mentioned above, and partly by the unusually simple and tidy picture presented by Hertzog. In order to duplicate Hertzog's sample as closely as possible, the subjects chosen were first-year nursing students at the Royal Alexandra Hospital, Edmonton, Alberta. For the pilot study, first-year nursing students at the University of Alberta Hospital, Edmonton were chosen. As a result of this study, a small modification was made to the technique of investigating visual set, but in such a way that it could only enhance the precision of measurement. Further, in attempt to find out whether one could establish more firmly that a set had been extinguished - to solve problem 3 - a separate study was carried out after the main study.

Pilot experiment.

A class of about fifty first-year nursing students at the University of Alberta Hospital was invited to volunteer for 'a simple experiment involving perceptual tests'. It was explained that further description could not be offered, as this might bias the test. All the students expressed willingness to participate.

Students were tested individually, and at the end of each experiment were asked not to discuss their experiences with other students.

Test for haptic set.

The equipment for this consisted of three wooden sheres of equal weight, approximately 6.5oz. (180gms.), and each provided with a handle. The diameters were 70mm, 70mm, and 100mm, identical in size to those used by Hertzog, and in the Soviet studies.

The subject was blindfolded, and asked to place her hands on her thighs, palms upward. A sphere was then placed in each hand, and she was asked, "Grasp the spheres briefly, and then tell me if they seem equal in size. If not, which one is the bigger? Please remember, I only want to know about the size, not the weight". In the first instance, the equal spheres were used, in order to check for response bias. Subsequently, the large sphere was placed in one hand, a smaller in the other, ('setting trials'). Two such trials were followed by a critical trial (equal spheres). If no illusion was found to be present, setting trials were resumed, groups of three setting trials being followed by a critical trial, up to a maximum of 17 setting trials (i.e. 2+5x3). Once a fixed set was established, critical trials (equal spheres) were continued until the subject demonstrated veridical perception by responding correctly five consecutive times, or to a maximum of thirty trials.

Test for visual set.

Subjects were tested in three ways, in an attempt to establish the reliability of Hertzog's method, and to establish whether there was a need for a test for perceptual bias, or error. Subjects were initially assigned at random to one of the three treatments, as they arrived, but when it became abundantly clear, after three or four subjects, that testing for error or bias was necessary, the number of treatments was reduced to two.

(1) Subjects treated identically to Hertzog's subjects, and the Soviet subjects:

The subject is told that she would be asked to judge the relative sizes of two circles, flashed for 0.1 seconds in the tachistoscope. She was to say whether the circles appeared equal in size, and if not, whether the one on her left or her right was bigger.

The pairs of circles, drawn with a ball-point pen, were black on white card. The equal circles were 22.5mm in diameter, the unequal ones 15mm and 30mm (again identical with earlier work). The centres of the circles were on the same horizontal line, 45mm apart.

The subject was first given two setting trials, the larger circle being on the right, followed by a critical test (equal circles). If no illusion was apparent, more setting trials were given in groups of three, each followed by one critical test, up to a maximum of 17 setting trials.

Once a set had been fixed, critical trials were continued up to a maximum of thirty trials. If the subject showed veridical perception five times consecutively, the set was taken as extinguished.

(2) In an attempt to eliminate the problem of subjects imagining that they saw minute differences where none existed - (bearing in mind that the subjects had no idea of what magnitude of a difference they were expected to distinguish) - they were told in advance that "differences would not be minute, not <u>really</u> small"s.

Subjects were then treated just as described above.

(3) For this group, in addition to the equal cards, four other pairs of cards (eight in all) were used, labelled "2", "3", "4", "5". (The subject did not see the labelling). The two cards of each pair showed two unequal circles; on one card of each pair, that on the left was bigger, on the other, that on the right. The circle-diameters for each card were:

2	28mm	30mm
3	26mm	30mm
4	21mm	30mm
5	15mm	30mm

(Thus the cards '5' were identical to those used in the

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[5] The author is, and was, well aware of the weakness of this measure. It <u>may</u> serve to delay the uncertainty, and that by an unknown amount. See the discussion on the post-experimental sample, below.

setting trials with everyone else).

Subjects were presented tachistoscopically with the nine cards, in random order, to test for adequacy of perception. In addition, in the particular case where a subject consistently reported the equal circles as "left bigger" (for example), the experimenter was now in a position to try to create a contrast illusion such that the subject with the illusion would report "right bigger" on seeing equal circles - i.e. the setting trials would have the left circle bigger. (Naturally, an assimilative illusion could not be detected this way, but it could not be detected for certain anyway). Without the trial runs with the different cards, one has no knowledge of the cause of a particular response.

Test for irradiation of set.

Subjects were asked to sit at the tachistoscope, one hand on each side, palms upwards. They were given the instruction:

"I am going to place a sphere in each hand. Please grasp them briefly and then let go. From time to time I shall flash a pair of circles. When I do, tell me if they appear equal, and if not, which one is the bigger. Don't say anything about the spheres, just the circles."
The subject was asked if she understood, and if not the instructions were explained again.

The subject was then twice presented with a large shere

in the left hand, a small sphere in the right (setting trials). Equal circles were then presented (critical trials). If no illusion was reported, then the pattern of three setting trials followed by one critical trial was repeated, to a maximum of 26 setting trials.

Note on the use of the pilot group.

Since the experiments on the pilot groups were intended to be exploratory, it was possible in some cases to add or modify tests. For example, in the last case above (irradiation), if a subject reported 'left bigger', according to Hertzog's criteria one would accept this as evidence of an assimilative illusion, and stop there. In the present case, the experimenter was free to continue and check the phenomena, to a slight extent. (Thus, if further responses, with no more setting trials, were 'right', 'left', 'equal', then one could clearly not infer a set at all).

However, the number of students coming forward to the individual sessions came to a halt too early to enable the author to reach an acceptable methodology, or to perform statistical tests between the groups. The main study was therefore entered with a number of queries still unresolved.

Main study.

In this part of the study, at the Royal Alexandra Hospital, a class of about 125 first-year nursing students was asked to volunteer for the experiment, as at the University of Alberta Hospital. One student declined afterwards. All the students were female, and the average age of the sample was 18.7 years. However, of these students, only 29 came forward for testing over a period of several weeks. Thus, except as regards total sample size, subjects were in all respects almost identical to Hertzog's, as far as his reported characteristics are concerned.

Students were tested individually, as before, and again subjects were asked not to discuss the experiment with fellow-students.

Test for haptic set

The test was carried out as described above. There was only one minor modification to the method of Hertzog and the Soviets (though, as will be discussed below, interpretation of the results is not straight-forward). The modification was this: if a subject, after a critical trial responded 'left' and then 'equal', the setting trials were resumed instead of continuing with critical trials. (For the purpose of assessing the number of trials to form a set, two methods were used, of which one was to stick as rigidly as possible to Hertzog's criteria, and the first 'left' response was taken as the result of a set. See the

discussion which follows the results).

Test for visual set.

This was carried out as in the pilot study, using the nine different cards before the setting trials to test for bias or perceptual difficulties. In addition, a few of the subjects were told that 'The differences you are looking for will not be very tiny'. The intention was to perform a statistical comparison between groups with and without this instruction (since the pilot study had not yielded the information), but once again, sufficient volunteers were not forthcoming at the time the tests were carried out. However, it will be seen that the effect was minimal.

Test for irradiation of set.

This was carried out as in the pilot study, and involves no modification of the Soviet method.

Final study - effect of training on recognition of circle-pairs.

It occurred belatedly to the author that one might train subjects to recognise (to some criterion) the nine cards described above for the visual setting task, before any setting was performed. It was thought that such training might illuminate the onset of the illusion, (in that if a subject demonstrates an illusion, we might assume that he thinks the circles are at least as much different in

size as the smallest difference shown to him. Naturally, he is told that only a restricted number of circle pairs is being used).

The experiment was carried out on 12 adult volunteers (two female) of the Division of Educational Research Services at the University of Alberta, with ages ranging from approximately 25 to 40.

It was first explained to the subjects what cards were available, and that only these cards would be used. Each was then displayed tachistoscopically for .1 seconds, and the subject stated which of the circles seemed bigger, or if they seemed equal. If he was wrong, he was told the correct answer, and shown the same card again. This training continued until subjects could correctly distinguish all five of the circle-pairs, on either left or right, twice, without intervening errors. Then the visual setting tasks and critical tests as described above were performed.

The results of the above studies are presented in the next chapter, along with some discussion of the problems of measurement.

CHAPTER IV

Results, and Commentary on the Measurement of Set.

As will appear from the report and discussion below of the experimental part of this thesis, the author found himself repeatedly forced to judge subjectively a subject's state of set, when such measurements have been portrayed as, and ideally ought to be objective. It may thus be claimed that the author's slight alterations of the previously-used techniques, and the application of judgement to each case in turn (that is, from the author's point of view, thinking about the meaning of each response sequence) are the cause of the discrepancies between this study and earlier ones. It is hoped to show that this cannot be the case. In particular, to attempt to confound the second argument, the author worked out what scores subjects would have obtained if measured as strictly as possible by the criteria of Hertzog and his predecessors (though even here it is occasionally quite impossible to be completely objective; to stick to the letter of this system would have been senseless. Examples will be given). For the various modalities, the correlation was then calculated between the author's 'common sense score' and the 'strict' score, for those subjects for whom both scores were available, (i.e. made sense) in each of the modalities. As will be seen, the correlation is high: the author's assessment of the subject's state of set could not differ significantly

from someone applying as strictly as possible the criteria baldly stated by the Soviets and later workers in the West.

Detailed statistics are presented only for the Royal Alexandra Hospital subjects, since these were the subjects given uniform treatment.

Total subjects exhibiting a clear set.

Out of 29 subjects tested, 24 formed a fairly clear set in the haptic modality, 4 formed no set and one suddenly reported with great clarity the attempt to form illusions, and was unable to report further on her simple perceptions. 11 of the 29 formed no visual set, and two more had perceptual problems such as prevented an assessment of visual set. This left fifteen who formed a set, though these were much less clear than in the haptic modality, where there was seldom doubt as to whether a set had or had not formed.

Of those showing haptic set, only five transferred the illusion to the visual modality, and these cases were dubious. The effect seemed to be extremely weak.

Below are presented tables of correlations between various setting modes. If Hertzog's hypotheses concerning flexibility and complexity were correct, these would all be expected to be highly correlated.

Correlations between set measures in haptic and visual modalities.

I - Based on author's 'subjective judgement'.

	Pearson r	N subjects	t	sig level°
Hap. formation vs extinction.	-.543	22	-2.90	.01
Vis. formation vs extinction.	.299	15	1.13	ns. at .2
Hap. formation vs vis. form'n	-.089	13	-.288	ns. at .2
Hap. extinction vs vis. ext'n.	.503	13	1.93	.05
Hap. formation vs irradiation.	-.323	5	-.591	ns. at .2

II - Based on 'strict' criteria.

	Pearson r	N subjects	t	sig level°
Hap. formation vs extinction.	-.600	22	-3.90	.01
Vis. formation vs extinction.	-.118	12	-.377	ns. at .2
Hap. formation vs vis. form'n.	-.223	13	-.760	ns. at .2
Hap. extinction vs vis. ext'n.	-.060	11	-.181	ns. at .2
Hap. formation vs irradiation.	-.323	5	-.591	ns. at .2

° The point of including the 'level of non-significance' is to emphasize the contrast with Hertzog's work. These entries might be read, "fails to reach significance even at the .2 level"; thus there can be no question of the results being 'marginal'. The t-tests are of course one-tailed.

The two tables above indicate that however set is measured, we cannot on this evidence claim for it the status of a 'unifying, integrating' aspect of human functioning.

Nor can we on this evidence divide subjects, for the purpose of examining other aspects of functioning, such as their language ability, into clearly distinct 'set types'. It is noted firstly that in the first table, only two values are 'significantly different from zero', and that the first of these correlations is negative - the reverse of what Hertzog hypothesizes. Naturally, the author regards the upper table as a more reliable reflection of the true state of affairs. Nevertheless, in the table using 'strict' criteria, only one significant result is found, again a negative correlation. The discrepancy between the Haptic extinction vs visual extinction in the two tables may be very reasonably attributed to the difficulty of measuring whether a subject has indeed extinguished or not. This problem is discussed in more detail below. The fact that in the second table all of the correlations turn out to be negative is of no consequence, since four of the five are non-significant. One should note also that the five correlations are also not statistically independent, so that the significance levels quoted are not strictly accurate. Naturally, this problem always arises when considering correlations from a set of variables where some or all of the same subjects supply the different measures on these variables.

Finally, it should be mentioned that there seems to be no simple way of accounting for these results as a consequence of sampling. It does not seem possible to argue on the basis of the subjects' state of 'set', since this is

apparently not measurable; perhaps a more imaginative investigator can suggest a reason why these particular volunteers (as opposed to the non-volunteers) should not have detectable set characteristics. In any case, the present author can think of no reasonable relationship between the hypothesized properties of set, and a 'tendency to volunteer', within a group of normal subjects.

In order to show that the discrepancy with earlier work does not arise entirely from the methods of assessing set from subjects' responses, we present the correlations between the two measures.

Correlations between author's 'subjective measures' and 'strict' criteria.

	Pearson r	N subjects	t	sig level
Formation of haptic set.	.701	22	4.40	.001
Formation of visual set.	.841	15	5.59	.001
Extinction of haptic set.	.803	22	6.02	.001
Extinction of visual set.	.883	12	5.95	.001

One sees immediately that the two measures are not so different that this factor alone can account for the discrepancies between this work and earlier work. It was not possible to compare the two measures on irradiation because three of the five poeple considered to have irradiated in the two assessment-systems were not the same.

(The identical correlations in the earlier tables were coincidental).

Some examples on the problem of interpreting set responses.

In these examples, the stimulus presented will be represented in upper case, the response in lower case. The letters R or L signify the bigger circle, E signifies 'equal'.

(1) Subject L.W. Haptic set.

LlLlErErEeErEeEeEeEeErEeEeEeEeEe

A fairly clear example. The set is considered established after two trials, and is counted extinguished (in either scoring system) after the final 'r'. Yet after the first four consecutive 'e' responses, could this not be perceptual error - especially as some students claimed to feel foolish "saying 'equal' all the time".

(2) K.R. Haptic set. This subject quickly formed a haptic set, with contrast illusion, but when tested again immediately after, formed an assimilative illusion. Why?

LlLlErErEeEeEeEeEe RrRrRrErEeErErErEeEeEeErErErEeEeEeEeEl
(test ended)

(3) B.B. Haptic set. This subject demonstrates the

inadequacy of the criterion of five 'equal' responses to judge extinction. The set forms in two trials, extinguishes in four:

LlLlErErErErEeEeEeEeEeEr

If the set were indeed extinguished at the fifth 'equal' trial, why the 'right' response on the next?

(4) L.S. (U. of A. Hospital). This 'pilot' subject apparently developed an assimilative haptic set, but on 're-setting' showed no illusion at all. Why?

LlLlElElElEeEeElEeEeEeEeEe LlLlLlEeEeEeEeEe

All the above were in the haptic modality, where the set is generally strong and clear - of over 50 subjects tested, only one showed no haptic set whatever. (She also had excellent visual perception - judging all nine pairs of circles correctly, and forming no visual set). The following examples are from the visual modality.

(5) L.W. Visual set. This subject demonstrates the inadequacy of the first response to equal circles being indicative of set.

RrRrElEeRrRrRrElEeRrRrRrEeEeEe

The first 'E-l' stimulus-response pair was not taken as

demonstrating set, so the setting trials were resumed. It could then be argued that the second 'E-1' pair suggests that a set is formed, and immediately lost. But why, then, after further setting trials - and we note that there are more setting trials than critical trials, so that a 'dilution' effect cannot be claimed - why is there no set after the last setting trials?

(6) G.P. Visual set. This subject, who showed quite adequate perception with the nine circle pairs, demonstrates what look like random responses, but which must, of course, be treated as 'set':

RrRrElElEeElErElEeEeEeElElErElElElElEr

Finally, the typical response to the transfer experiment was no illusions or errors at all. (It was as though subjects now having to hold on to something as well as look at something had 'decided' that less fine visual distinctions need be made). Of 22 subjects who could have irradiated set from the haptic modality, 17 made no errors at all when presented with equal circles in this experiment.

The test-retest data.

Regrettably, only five subjects were tested because of the unexpected failure of subjects to come forward . Since irradiation was found to be so weak generally, this was not

measured in the post-test subjects. (In fact, none of the five showed any pre-test irradiation). In order to have one clear method to start with, all the subjects chosen for the second test had formed a clear haptic set in the main study.

Haptic formation. One subject did not form a set in the post-test; the remaining four had identical scores to their pre-test scores, yielding a correlation of 1.0, for these four only.

Haptic extinction. One of the four subjects forming a set in the post-test did not extinguish by 30 trials. Giving her a score of 30 (which is questionable) yields a correlation of -.30 ('common sense' scoring), or +.30 ('strict' scoring).

Visual formation. One subject formed no set in the pre- or post-test. Another formed no set in the pre-test, and two others formed no set post-test. Hence no correlation could be calculated.

Visual extinction. Since four subjects did not form a set in one test or the other, no correlation could be calculated.

The study with the 'trained' group.

It will be remembered that the purpose of this experiment was to see if the patterns of response in the case of visual set would be changed by training, hopefully making clearer the point of set formation and extinction.

Of course, no statistical comparison with the experimental group is possible, since the two groups were not selected from the same population.

On the whole, the test was inconclusive. Subjects did not obviously take longer than the nursing students to form a set (as might have been expected), and the responses through the critical trials towards extinction were equally ambiguous. Most subjects behaved during the critical trials as though they had forgotten the instruction that only cards from the original nine would be shown. The experimenter could not, of course, keep on reminding them, as this would act as an additional stimulus to change the set.

CHAPTER V

Discussion

We are now in a position to examine the aggressive opening sentence of this thesis, in which it was suggested that 'the Soviet theory of set may be an appealing theory starting to run wild'.

Firstly, the theory is attractive because it seems to offer the psychologist a firm experimental hold on quantities relating to the most inward mental processes. One tantalizing hypothetical construct at least seems to have been cornered. Secondly, it is an attractive theory because it accords well with our intuitive knowledge of how we function. A little self-observation leaves one feeling that it would be difficult to get along without set. Thirdly, the foundations of the 'experimental hold' referred to above seem at first sight to be firm. The evidence outlined in Chapter I above seems to confirm and illustrate a well-coordinated theory. Thus, the adjective "appealing" would appear to be justified, and yet the inference that the theory is 'running wild' is inescapable from the material of the preceding two chapters.

Could this conclusion be an artifact of the present work, due perhaps to careless experimentation or freak conditions not noticed by, or visible to the experimenter? It could, of course, but there is a little more external

supporting evidence from the work of Alberta psychologists:

For example, Hritzuk (1968) investigated the relationship between set and three Eysenckian dimensions of personality: extraversion/introversion, hysteric/dysthymic, and neurotic/stable. He too made the same mistake as Hertzog in keeping separate the measures of fixation and extinction in the different modalities, and irradiation from the haptic to the visual modality. Once again, correlations are not stated[6]. Nevertheless, the tables presented provide interesting information regarding the process of fixation. For example,

Dysthymic subjects (15 out of 16) did not fixate in 25 trials in the visual modality. (Five hysterics failed to fixate) (page 103).

10 out of 14 subjects in the neurotic-stable comparison group (5 of each) failed to fixate visually, in 25 trials (p. 104).

4 out of 6 extraverts and all six introverts failed to excite visually (p. 105).

It is particularly worth noting that the distribution of responses in the visual groups is quite similar to that of Cowper's (1973) control subjects, i.e. those in whom no illusion had been established, (above, Chapter II).

Notwithstanding the disparity between the haptic and the visual set responses, Hritzuk does not question the

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[6] Dr. Hritzuk reports (private communication) that he "thinks he has seen a couple of tables of correlations somewhere in the Soviet literature, but is not sure".

nature of 'set', but turns to the different personality characterization systems of Norakidze and Eysenck as a possible explanation for his 'no difference' results. Yet, to repeat, if 'set' exists, surely two modes of perception should have similar characteristics, if the effect goes so deep as to affect personality (and perhaps language). But the fact that, while most subjects form a set in the haptic modality fairly easily, 41 out of 58 failed to form any set visually (25 trials) does not deter Hritzuk from his belief in 'set'!

Similarly, Janzen(1971) in a factor-analytic study involving set, personality, and language, found two weak factors, accounting for only 9.11% of the variance, 'calling to question the integrative nature of set'. Yet once again apart from this comment Janzen did not seriously question the concept. In his abstract he states,

> The eight factors are interpreted as minimally supporting Uznadze's contention regarding the orienting and integrating nature of set... However, since the set measures also have loadings together on one factor, they suggest the possibility that set is, in some degree, an independent phenomenon.

The correlations between the different setting modalities (which were not included in his thesis) are given below:

Correlations between various modalities (Janzen) °

		2	3	4	5
1	Hap. Excitat'n	-.03	.036	.071	.130
2	Hap. Extinc'n.		.158	.106	.013
3	Vis. Excitat'n.			.170	.202
4	Vis. Extinct'n.				.248
5	Hap. to vis. irradiation.				

° Private communication. Printed with Professor Janzen's kind permission.

Despite the fact that some of these values are "significantly different from zero" because of the large sample size, (186), the correlations are still low to be providing the basis for a whole theory. In particular, the haptic/visual excitation correlation and the haptic/visual extinction correlation should be particularly strong; they are .036 and .106.

Finally, it is clear that group differences in the extinction of a set may well be accounted for not by the set characteristics of the groups, but by personality characteristics of the subjects in the face of uncertainty, and previous commitment. And indeed, at the extremes of personality scales could not a particular imbalance be caused by a genuine disagreement in the information coming in to the brain from different modes of perception? What could be more disturbing than having one's eyes tell one at the simplest level that the object on the left is the

larger, while one's hands say the one on the right is bigger?

The comments above have applied mainly to fixated set, (relating to the quantitative illusion phenomena). Can one level similar criticisms at the Soviet work on 'qualitative set'? In places, one can, but the criticism is perforce more nebulous because of lack of detailed information in the English works. Here are some examples:

1. The very striking example is cited above (Chapter I) of subjects reading common Russian words written in neutral script as though they were foreign words. The question arises as to how the instructions were given to the subjects. We are simply told "German words written in Latin print are shown successively.... in order to establish a set", (Cole & Maltzman, 1969, p 616). Now of course, either the subject must have been fairly familiar with German, and have been told he was to read these German words, or the preceding "setting" words must have contained foreign (and non-neutral) letters, of which the subject must have had at least a slight familiarity, or both. It is essential to make the subject think he is reading foreign words in order to establish the set. Then the question becomes not "Why does this person read this (Russian) word as though it were foreign?" but "Why should the subject revert to Russian pronunciation?"

2. Natadze (1960) has described the production of haptic sets by having subjects imagine they were holding spheres of different sizes. From his description of the establishment of imaginally-produced sets, it seems that there can be no control on the subjects' veracity. The tests are, of course, tedious and time-consuming, and in the reported study stretched over a period of up to two weeks:

> It should be noted that most of the subjects... achieved the required vividness of image only at the price of great mental exertion, and only after a number of attempts had failed (Natadze, 1960, p 240).
>
> All subjects succeeded in developing a corresponding set after continued practice and by carrying out our instructions. The majority achieved this after a week's practice (one session a day); with some it took two weeks to do so (ibid, p 244).

We are not told what the 'instructions' consisted of, but it is clear that the subjects must quickly have learned the experimenter's aim. Patience - or lack of it - on the part of the subjects could have done the rest. Additionally, there is no mention of restricting communication between subjects, nor of controlling experimenter bias; the results confirmed that the better, more successful actors could establish set by imagining the situation. Did the experimenter know which of the subjects was which? We are not told. In some cases it seems unlikely that they could not have known; for example, one subject was a well-known comedian with a reknowned lack of ability at characterization (and who, like the failing drama students, had great difficulty in establishing an illusion

through the power of imagination). The essential point, though, is that in what must have been for the subjects an exasperating experiment, no control of the subject's reported illusion is possible.

3. The third and final example derives from the work of Eliava quoted above (Chapter I, p. 7) concerning set in thought, as reflected in unnoticed discontinuity in a text. We are told that "...Obviously, a selection of appropriate texts is of crucial importance in order to obtain the necessary effect" (supra, p. 7). The quotation is very revealing, and brings us to the heart of the difficulties of set theory, once we have lost the connection with fixated set.

Clearly, the presence of 'mental set' is being claimed after the event, and the experiment is arranged and rearranged as necessary ("the selection of appropriate texts is of crucial importance") until this is found. If a behaviour pattern expected as a result of set does not occur, then the experimenter argues that set had not been established, or had been established too weakly, and he can always use this argument. If a 'set-generating mechanism' is being claimed, it must be possible to specify ~~under~~ what conditions the mechanism will fail to work. Otherwise, there is no possibility of refutation unless independent phenomena exist which have been found to occur simultaneously with the establishment of set. The notion

that haptic and visual fixed set might serve this purpose seems to have been dispelled by the results of the present work. Hence there is no point in doing experiments to 'demonstrate' the presence of 'set' as the determiner of particular behaviours. Refutation is still the only acceptable test of a theory. A theory which is not in principle (at least) capable of empirical refutation is unscientific.

There exists a revealing (and beautiful[7]) analogy of this situation in the case of Chomsky's notion of linguistic competence, as it relates to grammars of a language. The concept is now becoming disreputable among psychologists for the very same reason: there is no way of disproving the conjectures of transformational generative grammar (when viewed as a psychological theory). Ironically, however, even the linguists are seeing the need to put people back into language because Chomskian-type grammars are <u>too</u> powerful. They can produce <u>anything</u> (almost). Fortunately, since a generative grammar is a formal system, such

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[7] The adjective 'beautiful' seems particularly apt. There are cases where the <u>omission</u> of value-judgements such as this would be ungracious, to say the least. In similar fashion, we do not allow ourselves to be restricted by artificial constraints of style from labelling Maxwell's theory of electro-magnetic phenomena, or his derivation of the Maxwell-Boltzmann Distribution Law as "beautiful". Indeed Dirac(1947) goes so far as to claim that if a theory is beautiful, it is unlikely to be wrong; if in doubt, better see first if the "facts" can't be changed! Thus, it is claimed that the algebraic proof of Peters and Ritchie that the very foundations of transformational generative grammar are, in effect, useless, truly deserves more than silent appreciation.

statements can be proven: Peters and Ritchie have shown that base grammars exist which can generate any natural language, and there is no means of distinguishing these from 'correct' grammars (psychologically speaking, that is, the grammars which a speaker might be assumed to use in producing an utterance), if these latter exist. See Wall (1971), pp. 700ff.

Wall states

> [Peters and Ritchie] were able to establish that the standard theory allows so much latitude in what can constitute a grammar... that it fails to distinguish natural languages from arbitrary recursively enumerable sets. More importantly, the theory is seen to be so powerful that certain questions which ought to have empirical content, such as whether or not all languages have the same base rules, in fact do not (ibid, p. 707).

It is unfortunate that the Soviet theory of set has not been, and presumably cannot be formalized, and thus become amenable to similar analysis.

The above specific, though incomplete criticisms of the Soviet theory of set can be readily couched in the language of Western psychologists, and within the conceptual framework of the structure of theories which by and large they accept. Especially useful is the formulation of Cronbach and Meehl(1955). These authors specifically emphasize (of test constructs) that "The investigation of a test's construct validity is not essentially different from the general scientific procedures for developing and confirming theories" (ibid, p. 300). This is essentially the point made above with reference to the theory of set

(pp. 50 - 52).

The fundamental problem of the theory of set emphasized in the present work is the difficulty of establishing reliable measures of this construct 'set'. Cronbach and Meehl state:

> A necessary condition for a construct to be scientifically admissible is that it occur in a nomological net, at least <u>some</u> of whose laws involve observables(1955, p. 290).

Uznadze does not give us a great deal to go on; for example,

> During the investigation of the living, integral man, of man himself and not the individual elements of his activity, we find that whenever a subject exhibits a need and the situation for its satisfaction is present, he develops a state of preparedness, a tendency, or, better still a set toward a definite activity giving him satisfaction. This set is the "modus" of the subject at each concrete moment of his activity, an integral state which differs fundamentally from all his differentiated mental powers and abilities.
>
> ....Obviously, therefore, the analysis of mental activity must begin with the study of the modification of the active subject as a whole, with the study of his set(Uznadze, 1966, pp. 204 - 205).

What are we to make of this? "Modus" apparently means the same as "set", so this is of no help. How are we to identify the "integral state" which, we are assured, changes as a subject develops "a set toward a definite activity"? Especially, be it noted, we must observe his "state of set" <u>before</u> the change, as well as after. The point is, not that we require an operational definition of 'set' itself, but that the construct must be embedded in a 'nomological net' in a fashion clearly relating it to at least a few distinct observables. "The construct is not 'reduced' to the

observations, but only combined with other constructs in the net to make predictions about observables" (Cronbach & Meehl, 1955, p. 290). But by what laws, other than the initial postulate of set theory are we to relate, for example, perceptual set and schizophrenia, or perceptual set and hysteria (assuming of course that the perceptual characteristics could be demonstrated unequivocally)?

> The investigator who proposes to establish a test as a measure of a construct must specify his network or theory sufficiently clearly that others can accept or reject it(Cronbach & Meehl, 1955, p. 291).

It might be argued that the demonstrated set properties of stability, variability, rigidity, lability, coarseness, plasticity... of fixed perceptual sets (Uznadze, 1966; Hritzuk, 1968; Prangishvili, 1973) are indirect verification of the genuineness of at least the perceptual set phenomena. However, with such a paucity of well-defined, measurable variables in the nomological net, a reasonable basic requirement would surely be one stable measure, or one varying predictably, and since the indications are that perceptual set is itself an elusive phenomenon to observe, it may well be that these technical terms are after-the-fact rationalizations. (cf. Cronbach & Meehl, p. 291: "...many such tests have been left unvalidated, or a finespun network of rationalizations has been offered as if it were validation. Rationalization is not construct validation"). And indeed, because the notion is so appealing in each particular application, one very easily falls into the way

of using the word "set" as though the construct was founded on a firm and wide base. Thus, for example, in a discussion with a faculty member regarding the apparent failure to extinguish a set in some subjects (in Soviet work), the present author pointed out the similarity with Cowper's(1973) results with control subjects. The faculty member countered by pointing out that by suggesting the possibility that the pairs of circles might be unequal, a set had been established, even in the control subjects. But, as in the case of Eliava's 'discontinuous text' situation, cited above, one can always use this argument. Refutation becomes impossible. Indeed, in the earlier chapters of this thesis, the writer used the word "set" as though it was a well-established construct; not to do so would in any case have have resulted in numerous circumlocutions and qualifications, both in reporting earlier work and in discussing the present work. In this fashion, a spurious air of solidarity and reality rapidly grows. As Feigl puts it,

> Familiarity breeds intuition; but it is neither a necessary nor a sufficient condition for scientific explanation (Feigl, 1959, p. 118).

Similarly, the experimental work of Bzhalava(1968) cited above (supra,pp. 8,9) was attributed to "set". And indeed, these ingenious experiments do point to some kind of unity of the different perception-modes when one object is focussed upon. But as one considers processes less and less peripheral, why should the internal organization, or

personality, (or "set") be the same for all aspects of functioning? Just where in the nomological net does the demand for this kind of unity arise? After all, our image of the external world must gradually arise from the corroborated experience of our different senses. They must sooner or later corroborate to make sense of the world. Then, in order to be able to function at a level higher than the worm or the caterpillar, perceptions must normally be relegated to some low level in our hierarchy of behaviours as complex animals. We do not under normal circumstances perceive our perceiving. This low-level perceiving can then easily be fooled by perfidious nature or an ingenious experimenter. An illusion formed as a consequence may be destroyed by the application of the higher, perhaps analytic levels. For example, the present author, being used as a 'guinea-pig' in the 'haptic spheres' experiment, came to the conclusion that something was amiss (having apparently formed a very strong and inflexible set) because it seemed to him that his tormentor could not possibly be changing the spheres so fast. Up to this point, the author had had the illusion of a whole sequence of spheres, of which that presented to the left hand was constantly being increased in size.

Finally, to return to the guidelines of Cronbach and Meehl, the requirement of correlation between two tests supposedly measuring the same construct is relevant to the present problem:

> If two tests are presumed to measure the same construct, a correlation between them is predicted... If the obtained correlation departs from the expectation, however, there is no way to know whether the fault lies in test A or in test B, or in the formulation of the construct. A matrix of intercorrelations often points out profitable ways of dividing the construct into more meaningful parts...(Cronbach & Meehl, p. 287).

The Soviet theory of set suffers two embarrassing weaknesses in this regard: the very small number of potential measures from which correlations could be calculated (i.e. the perceptual and irradiation measures), and the apparent lack of correlation between these measures in normal subjects, as far as one can tell from the present study and from those of Janzen(1971) and Hritzuk(1968). Indeed the more quantitative multitrait-multimethod matrix approach to construct validation (Campbell & Fiske, 1959) is completely ruled out.

In summary then, the theory of set is seen to have a number of major weaknesses: observables, along with their position in a nomological net are not clearly defined; the relationships defining an 'integral state of set' are not apparent; few variables are available on which reliable correlations can be calculated, and these are not of different types (providing a 'multimethod' approach); and it seems likely that many previous descriptions of 'set' may have been post-facto rationalizations. In addition to these theoretical problems (which are nevertheless of great practical importance), there seem to be severe limitations

on the experimental measurement of set, especially in the visual modality, and in irradiation.

However, there is another side to the picture, in that the language and vocabulary of the theory of set provide us with a way of looking at and describing human activity, a system which is remarkable in its appeal, and in its breadth of applicability. (We now refer to the application of the notion of 'set' in each separate instance, not as a 'global' characteristic of a person's behaviour). How useful this will be is not clear; it may be that some conception of 'set' will re-emerge as our understanding grows of the interactions and flexibilities and rigidities within and between subsystems of our brains and personalities, perhaps through the expansion of neuropsychology and systems theory, for example. In other words, the problem of set may be approached from other directions. Then our intuitions, through the language of set theory may meld our understanding. But until that time, we would seem to be in the clouds.

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APPENDIX

Glossary of set-theoretic terms

This glossary is not intended to be comprehensive. Only those terms used by the Soviets of particular relevance to this thesis are presented here. Terms are presented approximately in the order in which they occur in the text, which is also close to the order in which they would appear in a historical description of the progression from perceptual illusions to the notion of a global, integrating set-concept.

Fixed set. That set which is inferred from the illusions resulting from the repeated presentation of appropriate stimuli, which always have some characteristic (eg. size, weight) unchanged.

Critical trial. Following the repeated presentation of stimuli with some distinguishing characteristic, (eg. large on the left, small on the right), stimuli are presented which are equal in this respect. Such presentations are 'critical trials', and are the test for the establishment of an illusion.

Contrast illusion. That illusion which occurs in critical trials, when the subject observes that stimulus object to be smaller (lighter, etc.) which in the setting trials was bigger (heavier, etc).

Assimilative illusion. That illusion which occurs during critical trials when the subject reports the stimulus to be smaller (lighter, etc.) which during the setting trials was in fact smaller or lighter.

Set irradiation. The tranfer of set from one organ to another (eg. left hand to right) or from one sense modality to another. The illusion is said to be transferred. The set is said to irradiate.

Set fixation. The development of a state of readiness to act in a certain direction in the presence of a need, and a situation to satisfy that need. (Uznadze, 1961). In the case of the present experiments, and the work on qualitative set cited in the text, fixed set is usually established deliberately in the subject. In many life-situations, a fixed set may be maladaptive to some degree.

Set extinction. The gradual weakening of a set. For example, after experimentally 'setting' a subject to perceive equal spheres as unequal, he gradually begins to perceive them as equal again.

Objectivization. That process which is inferred when the smooth course of activity is interrupted so that the intruding complication, or phenomenon, or object becomes the focus of attention. Thus the 'plane of objectivization' is

the level of activity associated with intellectual behaviour.

Stable set. That set whose measurable properties do not change significantly over time. Also referred to as a 'constant set'.

Variable set. The set inferred when the measurable attributes, (eg. rate of formation of a fixed set), change from occasion to occasion. Usually, the occasions would not be within one experimental session.